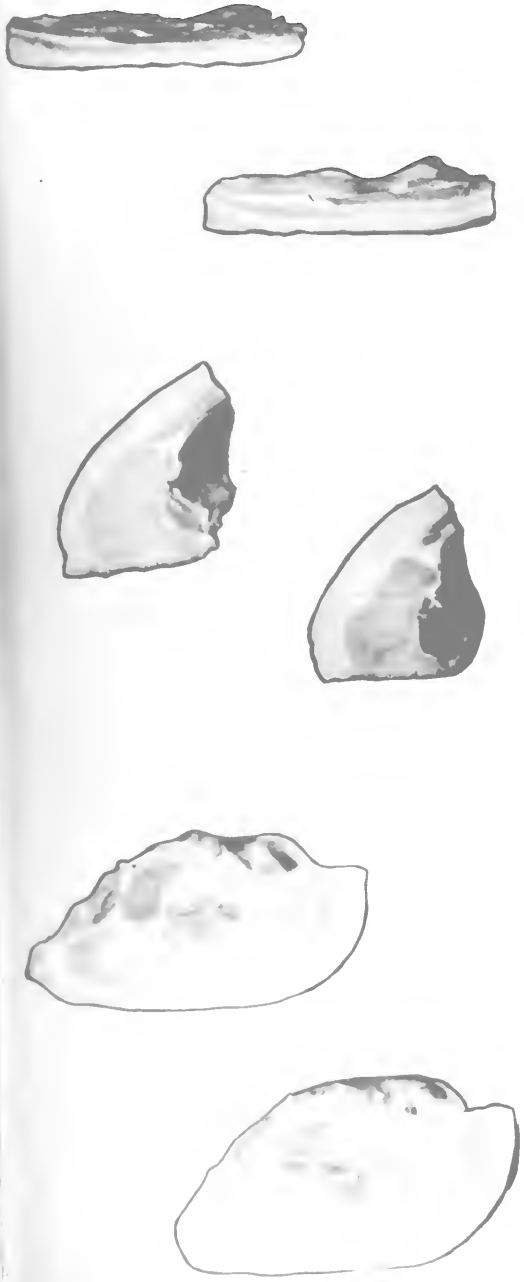
HOW MUCH AND WHAT KIND OF FAT IN THE SWINE CARCASS IS OFTEN INFLUENCED BY THE COMPOSITION OF THE RATION



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The Value of Inedible Animal Fats In Pig Rations

West Virginia University
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THE VALUE OF INEDIBLE ANIMAL FATS IN PIG RATIONS

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Introduction

Inedible fats are important livestock by-products. During recent years the market for such fats has been seriously curtailed and surpluses have become a problem. As a result the market value of inedible animal fats has decreased and this in turn has affected the market value of livestock.

Traditionally, the greatest utilization of tallow and grease, the two major types of inedible animal fats, has been in soap making. However, in recent years the demand for these fats by the soap industry has decreased. Soap production decreased from 3.66 billion pounds in 1947 to 2.26 billion pounds in 1952 and is still declining. During this same period grease and tallow used in soap making decreased from 1.53 to 1.08 billion pounds. It is expected to drop to 1.02 billion pounds by 1957. A gradual increase in the yearly production of inedible animal fats also contributes to the growing surplus.[1]

The addition of inedible animal fats to livestock rations would provide a practical answer to the surplus problem. It would also make it possible to increase the energy value of rations. Fat as an ingredient in rations must be considered primarily as a source of energy, and, as such, must compete with the cheapest non-fat energy source—usually corn. The energy value of corn is 3.5 calories per gram and that of fat is 9.0 calories per gram. On an energy basis one pound of fat would contribute 2.57 times more energy than one pound of corn. In addition, the energy in corn is only about 80 per cent digestible, whereas that in fats is considered to be from 90 to 95 per cent digestible.

The experiments described in this bulletin were conducted to determine the value of adding inedible animal fats to rations for growing and fattening pigs.

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[1]Ewell, R. H., "The Outlook for Inedible Fats and Oils," J. Agr. Food Chemistry 1:552 - 559, 1953.

Experimental Procedure

Eight trials involving 240 Berkshire and Duroc pigs were conducted to determine the value of lard oil and tallow in rations for growing-fattening pigs. The pigs were self fed or full-band-fed in concrete-paved pens.

When the pigs reached approximately 200 pounds they were slaughtered, and in Trials 1 and 2 the effect of the different treatments on carcass quality was determined. Measurements of backfat thickness were obtained in the area of the first, seventh and last thoracic and first lumbar vertebrae. A subjective hardness grade of very hard, hard, medium hard, medium soft, soft, or oily was assigned to each carcass after chilling. A sample of backfat was removed from each carcass from the center of the lumbar vertebrae region for iodine number determination.

The compositions of the experimental rations are given in Table 1. As mentioned previously, the feeding value of fat is largely dependent upon its energy value since it contains little, if any, of the other basic nutrients. Accordingly, as may be seen in Table 1, the amount of protein supplement and corn included in a ration was varied with the addition of fat so that the protein content of the rations fed in a trial was as nearly the same as possible.

Trials 1 and 2

Trials 1 and 2 were conducted to determine the value of an inedible animal fat—prime burning lard oil—upon the performance of pigs and to evaluate the effect of two surface active agents, Ethomid C/15 plus Arquad HT16 and choline chloride upon the utilization of the fat. The results of these trials are summarized in Tables 2, 3 and 4.

The effect of Ethomid C/15 and Arquad HT16 is not clear. In Trial 1 the rapidity of gain was improved but the efficiency of feed utilization was somewhat

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Table 1. Compositions of Experimental Rations

Ration Ingredients	Ration Number, Description, and Trial Ration used in, (in Order)											
	105 Control	120 Surfactant	121 Lard Oil	122 Lard Oil Surfactants	123 Lard Oil Choline	124* Control	125* 10% Tallow	126* 5% Tallow	127* 2.5% Tallow	130 Control	131 5% Tallow	132 8% Tallow
	1, 2	1, 2	1, 2	1, 2	1, 2	3, 4	3, 4	3, 4	3, 4	5, 6, 7,	5, 6, 7,	5, 6, 7,
	%	%	%	%	%	%	%	%	%	%	%	%
Ground Yellow Corn	70.0	68.0	60.0	58.0	59.0	58.5	47.0	52.5	55.5	74.0	66.5	62.5
Soybean Oil Meal, Sol.	25.0	25.0	25.0	25.0	25.0	-----	-----	-----	-----	17.5	20.0	21.0
Alfalfa Meal	2.5	2.5	2.5	2.5	2.5	7.0	7.0	7.0	7.0	5.0	5.0	5.0
Crushed Oats	-----	-----	-----	-----	-----	10.0	10.0	10.0	10.0	-----	-----	-----
Protein Mixture[1]	-----	-----	-----	-----	-----	21.0	22.5	22.0	21.5	-----	-----	-----
Lard Oil[2]	-----	-----	10.0	10.0	10.0	----	-----	-----	-----	-----	-----	-----
Tallow[2]	-----	-----	-----	-----	-----	-----	10.0	5.0	2.5	-----	5.0	8.0
Ethomid C/15[3]	-----	1.0	-----	1.0	-----	-----	-----	-----	-----	-----	-----	-----
Arquad HT16[3]	-----	1.0	-----	1.0	-----	-----	-----	-----	-----	-----	-----	-----
Choline Chloride Mix[4]	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	-----	-----
Vitamin A and D[5]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
B Vitamin Mix[6]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mineral Mixture[7]	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Calculated Digestible Protein %	14.48	14.64	13.62	13.98	13.96	14.72	14.60	14.74	14.73	12.17	12.61	12.78

*These rations were fed until pigs reached 150 pounds. Protein content reduced by approximately 2% from 150 pounds to 200 pounds.

[1] Composed of 500 pounds digester tankage and 1,000 pounds soybean oil meal, solvent extracted.

[2] Stabilized with 1 pound of Tennox III per ton of fat. Chief ingredient of Tennox III stated to be butylated hydroxyanisole.

[3] Surfactants were premixed in wheat shorts so that rations contained .05% Ethomid C/15 and .025% Arquad HT16.

[4] Mixed in wheat shorts so that ration contained 0.1% Choline Chloride.

[5] Dry concentrate containing 4,000 I.U. Vitamin A and 300 I.U. Vitamin D per gram.

[6] Wheat shorts premix providing 3.7 mg. riboflavin, 12.5 mg. niacin, 18.5 mg. calcium panthothenate and 9.0 mcg. vitamin B_{12} per pound of ration.

[7] 100 pounds steamed bone meal, 50 pounds salt, 50 pounds ground limestone, 400 gms. ferrous sulfate, 30 gms. manganese sulfate, 15 gms. copper sulfate, 30 gms. cobalt chloride, 30 gms. potassium iodide.

Table 2. The Feeding Value of Lard Oil and the Influence of Surface Active Agents and Choline Chloride on its Utilization by the Pig–Trial 1, January 14 - March 4, 1953

Ration Ingredients	Ration Number and Description				
	105 Control	120 Surfactants	121 10% Lard Oil	122 Surfactant + 10% Lard Oil	123 Choline + 10% Lard Oil
No. of pigs in trial	8D2B*	7D2B	7D1B	7D2B	7D1B
Avg. initial weight, lbs.	89.3	89.9	95.0	102.0	108.0
Avg. final weight, lbs.	177.2	182.5	194.4	201.7	210.4
Avg. daily gain, lbs.	1.79	1.89	2.03	2.04	2.09
Avg. daily feed consumed, lbs.	5.57	6.43	5.14	5.66	5.58
Feed consumed/100 lbs. gain, lbs.	312.9	340.2	253.2	277.5	267.0

*D and B refer to Duroc and Berkshire respectively.

Table 3. The Feeding Value of Lard Oil and the Influence of Surface Active Agents and Choline Chloride on its Utilization by the Pig–Trial 2, Durocs, June 17 - August 31, 1953

Ration Ingredients	Ration Number and Description				
	105 Control	120 Surfactants	121 10% Lard Oil	122 Surfactant + 10% Lard Oil	123 Choline + 10% Lard Oil
No. of pigs in trial	5	5	5	5	5
Avg. initial weight, lbs.	75.2	79.1	74.4	76.1	75.1
Avg. final weight, lbs.	200.2	209.8	217.9	215.2	219.4
Avg. daily gain, lbs.	1.67	1.74	1.91	1.85	1.92
Avg. daily feed consumed, lbs.	6.38	6.39	5.96	5.93	5.96
Feed consumed/100 lbs. gain, lbs.	382.7	366.8	311.6	319.8	309.6
Ave. backfat thickness, inches	1.47	1.51	1.61	1.47	1.64
Hardness grade, avg. numerical value*	5.0	5.6	4.2	3.6†	5.0
Avg. iodine No.	65.3	64.6	69.3	69.8	67.8

*Very hard 6, hard 5, medium hard 4, medium soft 3, soft 2, oily 1.
†One under-finished carcass graded soft, all others graded medium hard.

decreased. In Trial 2 the rapidity of gain and feed utilization in the Duroc lots were improved, but the Berkshires were apparently adversely affected by the treatment.

In both trials the inclusion of 10 per cent fat in the ration resulted in an improvement in rate and efficiency of gain. The rate of gain was increased by about 14 per cent, and the feed required for each 100 pounds of gain was reduced by about 18 per cent. The addition of choline chloride or the surfactants to the high-fat ration did not improve performance except possibly in the case of the Berkshires in Trial 2. This difference is believed to be due largely to the poor performance of one animal in the lot that received Ration No. 121.

The high-fat rations fed in these trials resulted in an increase in the average backfat thickness of about 0.13 inches. This increase could be attributed to heavier slaughter weights of the fat-fed pigs. However, in Trial 3 the backfat thickness of the tallow-fed pigs was greater than that of the pigs fed the regular ration, although the slaughter weight of the animals was almost the same.

Carcass firmness, as measured manually, was decreased from an average grade of very hard-hard to hard-medium hard. Since the lard oil fed in these trials was unsaturated or soft it is not surprising that carcass firmness was decreased. This is illustrated by the iodine values obtained for the backfat samples taken from carcasses produced on the different rations. The iodine number of the lard oil was 69 and the iodine number of the backfat from pigs fed 10 per cent of lard oil in their rations ranged from 67.8 to 69.8, whereas the values obtained for pigs fed the regular rations ranged from 65.3 to 69.3.

Trials 3 and 4

The results obtained in Trials 1 and 2 showed that the addition of 10 per cent prime burning lard oil increased the rate and economy of gain. However, this soft fat, which is easily mixed into a ration, produced carcasses which were not as firm as those produced on the regular rations. Because of this effect, tallow, which is a saturated or hard fat with an iodine number of about 35, was used in Trials 3 and 4. Three levels of tallow were added to the rations fed, 2.5, 5.0, and 10.0 per cent. The results obtained in Trial 3 are shown in Table 5 and those for Trial 4 are shown in Table 6.

Improvement in rate and economy of gain with the inclusion of 10 per cent fat in the ration was not as great in Trial 3 as it was in Trials 1 and 2. As may be seen in Table 5 the presence of 10 per cent tallow in the ration improved the average daily gain by about 9 per cent and reduced the feed required by about 12 per cent.

The addition of 5.0 or 2.5 per cent tallow to the ration did not increase rapidity of gain but did reduce the feed required to produce 100 pounds of gain. When 5 per cent tallow was present in the ration 45 pounds less feed was required for each 100 pounds of gain, and 8.3 pounds of feed was saved when 2.5 per cent tallow was fed.

Addition of 10 per cent of tallow in the ration increased backfat thickness by 0.17 inches, or about as much as was recorded in Trials 2 and 3. Backfat thickness was not measureably increased, however, when 5.0 or 2.5 per cent tallow was fed.

The carcasses produced in this trial were hard (see iodine values for backfat in Table 5).

Table 4. The Feeding Value of Lard Oil and the Influence of Surface Active Agents and Choline Chloride on its Utilization by the Pig—Trial 2, Berkshires, June 17 - August 31, 1953

Ration Ingredients	Ration Number and Description				
	105 Control	120 Surfactants	121 10% Lard Oil	122 Surfactant + 10% Lard Oil	123 Choline + 10% Lard Oil
No. of Pigs in trial	5	5	5	5	5
Avg. initial weight, lbs.	40.8	41.0	39.0	40.7	39.4
Avg. final weight, lbs.	218.8	214.6	220.1	232.4	229.4
Avg. daily gain, lbs.	1.62	1.58	1.65	1.74	1.73
Avg. daily feed consumed, lbs.	5.60	5.80	5.03	5.05	5.00
Feed consumed/100 lbs. gain, lbs.	346.1	367.5	305.7	298.8	289.2
Avg. backfat thickness, inches	1.59	1.55	1.75	1.78	1.80
Hardness grade, avg. numerical value*	6.0	5.6	5.4	5.0	5.4
Avg. iodine No.	63.8	63.5	68.2	68.7	68.0

*Very hard 6, hard 5, medium hard 4, medium soft 3, soft 2, oily 1.

Table 5. The Value of Tallow in Rations for Growing-Fattening Pigs—Trial 3, Durocs, January 21 - March 7, 1954

Ration Ingredients	Ration Number and Description			
	124 Control	125 10% Tallow	126 5% Tallow	127 2.5% Tallow
No. of pigs in trial	9	9	9	9
Avg. initial weight, lbs.	102.5	98.9	99.9	100.4
Avg. ending weight, lbs.	204.4	209.6	203.6	201.3
Avg. daily gain, lbs.	1.85	2.01	1.88	1.83
Avg. daily feed consumed, lbs.	8.73	8.42	8.08	8.53
Feed per 100 lbs. gain, lbs.	473.2	418.3	428.4	464.9
Avg. backfat thickness, inches	1.62	1.79	1.57	1.58
Avg. firmness value	5.4	4.9	4.9	5.1
Avg. iodine No.	62.9	63.8	64.5	61.8

Table 6. The Value of Tallow in Rations for Growing-Fattening Pigs—Trial 4, July 2 - September 17, 1954

Ration Ingredients	Ration Number and Description			
	124 Control	125 10% Tallow	126 5% Tallow	127 2.5% Tallow
No. of pigs in trial	7*	7	7	7
Avg. initial weight, lbs.	38.9	38.8	38.5	38.6
Avg. ending weight, lbs.	154.9	165.6	165.2	154.1
Avg. daily gain, lbs.	1.51	1.66	1.65	1.50
Avg. daily feed consumed, lbs.	4.75	4.70	4.87	4.44
Feed per 100 lbs. gain, lbs.	314.6	283.1	295.2	296.0

*3 Durocs and 4 Berkshires were fed each ration.

In Trial 4 the different levels of fat were fed during the period when growth is greatest and the trial was terminated before the pigs reached a marketable weight. The results obtained are presented in Table 6. In this trial the presence of 2.5 per cent tallow in the ration did not result in an improved rate of gain but did reduce the feed required for 100 pounds gain by 18.6 pounds, or a saving of 6 per cent. Addition of 5.0 per cent tallow in the ration increased the average daily gain by 0.14 pounds and the feed required per unit of gain was decreased by about 6 per cent. The feed required for a unit of gain was about the same when 2.5 or 5.0 per cent tallow was fed, but the average daily gain of pigs fed the ration containing 5.0 per cent tallow was 0.15 pounds greater.

Pigs fed the ration containing 10 per cent tallow gained as rapidly as those fed 5.0 per cent tallow, or about 10 per cent faster than the pigs fed the regular ration. Feed required was reduced by 10 per cent when the ration contained 10 per cent tallow. This represented a saving of about 3 per cent in feed above that required when the ration fed contained 5.0 per cent tallow.

Trials 5, 6, 7, and 8

These trials were conducted to determine the value of tallow for pigs during the finishing period. The results of previous trials suggested that a level of 5 to 10 per cent tallow in the ration produced the most satisfactory response. In Trials 5 and 6, 5 per cent tallow was included in the ration and in Trials 7 and 8 levels of 5 and 8 per cent tallow were fed. The results of these trials are summarized in Tables 7 through 10.

In Trials 5 and 6 feeding a ration containing 5 per cent tallow during the finishing period resulted in an increase in the rate of gain. The average daily gain was increased by 0.21 and 1.27 pounds in Trials 5 and 6 respectively. This represents a 10 and 14 per cent increase in rate of gain during the twenty-eight-day period. In both trials the tallow-fed pigs used their feed more efficiently but the improvement was small, being about 2 per cent.

In Trial 7 the presence of 5.0 per cent tallow in the ration did not increase the rate of gain but did improve the efficiency of feed utilization by about 10 per cent. When the ration contained 8 per cent tallow the pigs gained 0.22 pounds more per day with 17 per cent less feed than the pigs fed the regular ration. The difference in performance between the pigs receiving rations containing 5.0 and 8.0 per cent tallow was almost as great as the difference between the pigs receiving the regular ration and those fed 5.0 per cent tallow.

The performance of the pigs in Trial 8 was very similar to that recorded for those in Trial 7. Pigs fed the ration containing 5.0 per cent tallow gained 0.13 pounds more per day with 10 per cent less feed than the pigs fed the regular ration. When 8.0 per

Table 7. The Value of Tallow in Finishing Rations for Pigs—Trial 5, Durocs, July 23 - August 20, 1954

Ration Ingredients	Ration Number and Description	
	130 Control	131 5% Tallow
No. of pigs in trial	7	7
Avg. initial weight, lbs.	150.6	149.7
Avg. ending weight, lbs.	199.2	204.2
Avg. daily gain, lbs.	1.74	1.95
Avg. daily feed consumed, lbs.	6.37	7.29
Feed per 100 lbs. gain, lbs.	366.1	373.8

Table 8. The Value of Tallow in Finishing Rations for Pigs–Trial 6, Berkshires, August 20 - September 17, 1954

Ration Ingredients	Ration Number and Description	
	130 Control	131 5% Tallow
No. of pigs in trial	7	7
Avg. initial weight, lbs.	143.1	143.4
Avg. ending weight, lbs.	190.7	198.6
Avg. daily gain, lbs.	1.70	1.97
Avg. daily feed consumed, lbs.	6.67	7.55
Feed per 100 lbs. gain, lbs.	392.4	383.2

cent tallow was fed, the average daily gain was increased by 0.11 pounds and the feed required reduced by 13 per cent.

Discussion

Either or both the rate and efficiency of gain was improved by including a good quality inedible animal fat in rations fed to growing-fattening pigs. The improvement in performance varied from trial to trial and with the amount of inedible fat included in the ration. This is shown in the summary given below.

Level of Fat Fed	Improvement in Performance Over Controls	
	Average Daily Gain	Feed Efficiency
%	%	%
2.5	0	1.6 - 9.9
	0/2*	2/2
5.0	1.6 - 15.8	2.3 - 10.2
	5/6	5/6
8.0	6.0 - 11.6	13.3 - 17.2
	2/2	2/2
10.0	1.8 - 14.4	11.6 - 19.1
	5/5	5/5

*The denominator indicates the number of groups in which a given level of fat was fed and the numerator indicates the number of groups in which an improvement in performance was observed.

Table 9. The Value of Tallow in Finishing Rations for Pigs–Trial 7, Durocs, February 9 - March 2, 1955

Ration Ingredients	Ration Number and Description		
	130 Control	131 5% Tallow	132 8% Tallow
No. of pigs in trial	9	9	9
Avg. initial weight, lbs.	144.3	145.1	142.9
Avg. ending weight, lbs.	184.3	183.9	187.5
Avg. daily gain, lbs.	1.90	1.85	2.12
Avg. daily feed consumed, lbs.	7.63	6.67	7.05
Feed per 100 lbs. gain, lbs.	401.6	360.54	332.6

Table 10. The Value of Tallow in Finishing Rations for Pigs–Trial 8, Berkshires, February 9 - March 16, 1955

Ration Ingredients	Ration Number and Description		
	130 Control	131 5% Tallow	132 8% Tallow
No. of pigs in trial	9	9	9
Avg. Initial weight, lbs.	127.3	129.1	128.1
Avg. ending weight, lbs.	191.6	198.2	196.2
Avg. daily gain, lbs.	1.84	1.97	1.95
Avg. daily feed consumed, lbs.	7.71	7.45	7.08
Feed per 100 lbs. gain, lbs.	419.0	378.2	363.1

No appreciable difference was found in the backfat thickness of carcasses of pigs fed control rations and pigs fed rations containing 5 per cent of fat. However, when the ration contained 10 per cent of fat the backfat thickness was increased on the average by 0.15 inches. With the present emphasis on lean pork, this increase is certainly undesirable.

In addition to improving performance, the inclusion of fat in the rations lowered feed wastage, reduced dust, and improved the appearance of the feed.

As mentioned previously, the nutritive value of a fat is almost entirely due to its energy content. Accordingly, the actual worth of fat for feeding purposes should, to a large extent, depend upon its market price in comparison to that of corn which is usually the major source of energy in rations. Such a comparison, however, may be misleading because fat cannot be substituted directly for corn without lowering the protein content of the ration. In these experiments the protein content of the rations used in a trial was as nearly the same as was possible. In order to accomplish this the amount of protein supplement included was increased at the expense of corn with additions of fat. It would seem then that the value of fat in a feed could be determined on the basis of the improvement in the utilization of the whole ration rather than upon the basis of a replacement for corn. On this basis the performance of pigs fed rations containing 5 or 8 per cent fat show that each pound of fat resulted in a savings of about 2.1 pounds of feed. The values presented in the following table (Value of Tallow) are based upon this relationship. These figures offer an estimate of the maximum price a feeder can afford to pay for an inedible animal fat on the basis of the expected improvement in feed use and does not consider the advantages resulting from the increase in rate of gain.

VALUE OF TALLOW

Cost of Ration cents per lb.	Maximum Feed Replacement Value of Tallow cents per lb.
2.50	5.25
2.75	5.77
3.00	6.30
3.25	6.82
3.50	7.35
3.75	7.87
4.00	8.40
4.25	8.92
4.50	9.45
4.75	9.97
5.00	10.50

Summary

The inclusion of 2.5, 5.0, 8.0, or 10 per cent of an inedible animal fat in rations fed to growing-fattening pigs improved performance. The response varied with the amount of fat included in the ration. Improvement in performance when a given level of fat was included in the ration varied from trial to trial. The results suggest, however, that the most efficient use of the added fat was obtained when the ration contained 5 or 8 per cent.

Feeding an unsaturated or soft fat such as lard oil reduced the firmness of carcass fat. Thickness of carcass backfat was not increased when 2.5 or 5.0 per cent of fat was added to the ration. However, average backfat thickness was increased by 0.15 inches when 10 per cent of fat was included.

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